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**REMARKS**

Claims 1-3 and 5-16 are pending. The Applicant herein respectfully requests further examination of the application and reconsideration of the claims, in view of the amendments and remarks presented herein.

**Rejection under 35 USC §112, paragraph 2**

The Applicants respectfully address the issue raised with respect to claim 4 to expedite the prosecution of this case by canceling the claim and incorporating the claim limitation into claim 1. The Applicants further herein remove the parentheses from claim 15, as objected to by the Examiner, and amend the language of the claim to more particularly point out and claim the subject matter. The Applicants accordingly respectfully request the Examiner to withdraw the rejections.

**Rejection under 35 USC §103(a)**

The Examiner has rejected the subject matter of claims 1-16 as obvious to one of ordinary skill in the art at the time of the invention. Particularly, it is alleged that one of ordinary skill in the art would have been motivated to combine the disclosure of Winters, *et al.*, '389 with that of Westerlund '497 to reach the subject matter within the scope of claims 1-16.

► The key feature of the Applicants' invention is the use of Urea as the reducing agent, *per se*, to produce high purity  $\text{ClO}_2$  in sharp contrast to teachings in the prior art. Indeed, Urea has not previously been employed, in the manner taught and now claimed by the Applicants, to produce chlorine dioxide.<sup>1</sup>

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<sup>1</sup> As stated in the Applicants' Specification, currently available methods wherein NaCl or HCl are employed as reducers normally produce a mix of 67%  $\text{ClO}_2$  and 33%  $\text{Cl}_2$ . In contrast, methods of the current invention produce  $\text{ClO}_2$  with over 95% purity. Prior methods moreover require subsequent re-purification processes in order to provide  $\text{ClO}_2$  free of  $\text{Cl}_2$ . Methods of the present invention, however, do not require re-purification prior to use of  $\text{ClO}_2$  produced thereby. The Applicants' invention overcomes many drawbacks of traditional methods by using a stable new reducer in a safer new chemical process. See, e.g., Applicants' Specification at page 5, line 9, *et seq.*

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The Applicants respectfully point, however, that neither Westerlund or Winters, *et al.* contemplate Urea ( $(\text{NH}_2)_2\text{CO}$ ) as the reducing agent, per se, for reducing alkaline chlorate in a reaction, *per se*, to produce Chlorine Dioxide ( $\text{ClO}_2$ ).

#### Westerlund '497

Westerlund merely contemplates the *optional* employment of a *de minimus* amount of one of a series of possible chlorine reducing agents (i.e., selected from the group consisting of methanol, hydrogen peroxide, urea, acetic acid and ammonia) to reduce chlorine gas to chloride. "The provision of a chlorine separating system which employs weak hydrogen chloride water solution for suppressing the solubility of chlorine, may also add a chlorine reducing agent for zero chlorine, and the subsequent desorption step for the recovery of chlorine dioxide." '497, col. 33, lines 4-9. Indeed, urea is not even preferred by Westerlund for *this* function. '497, col. 31, lines 55-63 ("[t]he uniquely suitable agent is methanol ..."); col.32, lines 28-30 (the amount of chlorine can be reduced to HCl by addition of hydrogen peroxide or methanol ...). The Westerlund claims specifically recite, for example (emphasis added):

10. The continuous process of claim 1 including the step of: adding a reducing agent selected from the group consisting of methanol, hydrogen peroxide, urea, acetic acid and ammonia to said chlorine dioxide synthesis zone for the purpose of lowering by-product chlorine gas generation, thereby to provide zero destruct.

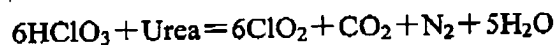
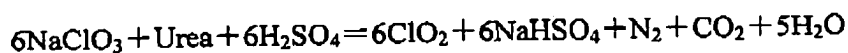
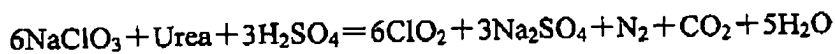
*See, also*, e.g., claim 73: The continuous process of claim 72 wherein chlorine in said solution is reduced to chloride by the addition of an agent selected from the group consisting of hydrogen peroxide, urea, acetic acid, ammonia and methanol at high acidity.

**In sharp contrast, urea is a main reactant in the Applicants' methods.**

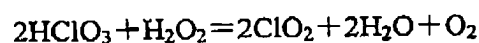
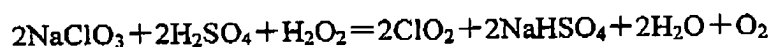
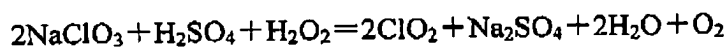
The Applicants' disclosure teaches  $(\text{NH}_2)_2\text{CO}$  as a critical element, i.e., the reducing agent of alkaline chlorate for the production of chlorine dioxide. In view of the differences of action, the amounts of urea used in chlorine dioxide production are much different, i.e., about 10-20% in methods of the Applicants' invention, based on total amount of  $\text{NaClO}_3$ , for example.

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Therefore, in the instant disclosure, urea is a main reactant as illustrated in the following equations set forth at page 4, lines 17-20, of the instant Specification:



However, in the disclosure of Winters *et al.*, because Urea is merely contemplated as a stabilizer for hydrogen peroxide, it does not appear in the reaction equations in producing chlorine dioxide. These reaction equations are as follows:



In which hydrogen peroxide is the sole reducing agent. Only about 0.01~5% of a chlorine reducing agent, e.g., Urea, is contemplated within the disclosure of Winters *et al.*, based on total amount of hydrogen peroxide. Moreover, the amount of hydrogen peroxide is only about 10~20% total amount of  $\text{NaClO}_3$ .

The Applicants further point out that in methods of the present invention urea is employed not only as a reducer in chlorine dioxide production but as a source of nitrogen in the production of binary/ternary compound fertilizers. See, e.g., claim 15. Jointly producing inorganic salts and/or compound fertilizer processes greatly reduces the production cost of  $\text{ClO}_2$ .<sup>2</sup> Traditional methods with  $\text{NaClO}_3$  as raw material and  $\text{H}_2\text{SO}_4$  as reaction medium will normally result in by-products of sodium sulfate or sodium bisulfate, both of which have little use and have to be disposed of properly. The method of the invention can convert them into potassium sulfate that can be used as fertilizer. If using nitric acid or phosphoric acid as a reaction medium, the method of the invention can directly produce by-products such as sodium nitrate, sodium biphosphate and sodium hydrogen phosphate, all of which are widely used chemical products. If using  $\text{KClO}_3$  as raw material and sulfuric acid, nitric acid, or phosphoric

<sup>2</sup> Specification, page 6, lines 6-11.

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acid as reaction medium, the method of the invention will directly produce highly pure and useful inorganic salts such as potassium sulfate, potassium nitrate and potassium biphosphate.

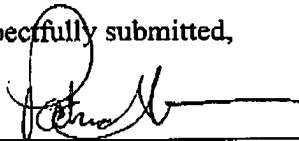
The Applicant accordingly respectfully requests that the Examiner withdraw the rejection under 35 USC §103(a).

\* \* \*

For the foregoing reasons, the Applicant submits that Claims 1-3 and 5-16 are in condition for allowance. Early action toward this end is courteously solicited.

The Commissioner is authorized to charge any deficiency or credit any overpayment to Deposit Account No. 50-1943.

Respectfully submitted,



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